CONFIG = CF9
SAVE PRM CONF
CF10

INSTRUCTION MANUAL

EICO

147 A SIGNAL TRACER

147A-3

EICO

108 New South Road, Hicksville, N.Y. 11801

of these important measures toward hum reduction, inherent hum is extremely low and the hum heard while using the high gain (RF) input can be classified as grid hum. As the RF probe circuit actually constitutes an extension of the V1A triode grid circuit, this is understandable.

It is only natural that there be some hum when the high gain input channel is used with the gain control set at maximum. While a triode is used as the input stage, which is desirable, a certain amount of sporadic microphonic operation is normal and to be expected. Almost any tube used in this application would exhibit this condition to some extent. However, it should be possible to use maximum gain without meeting a continuous microphonic condition.

operation

GENERAL

Signal tracing a receiver consists of following or tracing a broadcast signal or the radio-modulated output of an r-f signal generator through the various stages of a receiver by connecting an indicating device, such as a signal tracer, first to the input and then to the output of each succeeding stage. The trouble is thereby located in the stage between the point at which the desired signal disappears or is not of proper strength, or an undesired signal (such as hum, noise, or oscillation) appears, and the last previous point at which no trouble was encountered. Once the defective stage is located, control and operating voltage checks are made, which, if necessary, are followed by d-c resistance checks and special component tests such as tube tests, value and leakage checks of capacitors, and noise locator tests. These tests allow the final determination of the defect in the stage which signal tracing has localized as the source of the trouble.

A good r-f signal generator is highly desirable for signal tracing (especially in weak signal areas) since it provides a steady signal of controlled strength and frequency as well as constant audio-frequency modulation. This is particulary important in estimating signal level and gain-per-stage with the electron-ray indicator or an external VTVM or 'scope. For detecting distortion, however, it is preferable to employ a broadcast signal, since distortion in music or speech can be detected much more readily by ear than distortion in a single-frequency tone. Of course, if distortion is to be detected visually with a 'scope, the single-frequency modulated output of a signal generator must be used, as distortion would be impossible to detect visually in the varying complex tone of music or speech.

In checking f-m sets or the sound section of a tv receiver, it is not necessary to use a frequency-modulated signal except in the a-f section. An a-m carrier can be traced using the RF channel as far as the ratio detector; or if a phase discriminator is used, it can be detected as an d-c voltage in the output circuit of the discriminator. To determine proper operation of the a-f stage, an a-m signal can be fed to the receiver at the antenna input terminals. Sufficient audio signal will get through to provide a quality check. As with a-m receivers, distortion is checked by listening to broadcast music or speech.

Obviously, all-wave receivers can be checked on the broadcast band as well as an ordinary a-m receiver. If the defect is encountered on all bands, it will be revealed by signal tracing on the broadcast band. If the defect is encountered on one band and not on the others, then the trouble is in the r-f, mixer, or oscillator sections since the rest of the receiver is the same on all bands. If the oscillator and mixer sections check properly, then the trouble is localized to the r-f section. It is recommended that the r-f signal generator be set at 600 kc for testing standard a-m broadcast and all-wave receivers since the capacity of the ganged tuning capacitor in the receiver is high when set to tune in this frequency. As a result, the additional shunt capacity introduced by connecting the test probe to the circuit will not cause appreciable detuning.

RF SIGNAL TRACING

Connect the RF probe to the panel connector marked RF INPUT. Set the INPUT SELECTOR at RF. Set the OUTPUT SELECTOR at TRACE if the aural (speaker) monitor is desired or at TEST SPKR-TEST AMPL if it is more convenient to work with the speaker off and a VTVM or 'scope is connected to the VTVM-SCOPE jack.

The eye tube indication is the size of the shadow angle (dark sector). The larger the signal voltage applied to the grid of the eye tube, the narrower the angle; the smaller the signal voltage, the wider the shadow angle. Two factors control the magnitude of the signal voltage applied to the eye tube grid and therefore the size of the shadow angle. One is the strength of the signal at the point to which the probe is touched; the other is the setting of the GAIN control. To maintain a constant shadow angle of any desired magnitude that you may choose as a reference level, normally you must reduce the GAIN control setting (turn it counter-clockwise) progressively as you trace the signal thru the receiver point-by-point starting from the antenna input terminals. With practice, you will get to know whether the gain of a particular stage is approximately normal by how much the GAIN control setting needs to be decreased in order to maintain a constant shadow angle as you move the test probe from the input to the output of the stage. Checking for normal gain-per-stage by

GENERAL DESCRIPTION

The EICO Model 147A Signal Tracer is a deluxe instrument crammed with unsurpassed testing facilities and conveniences for efficient, profitable servicing of am, fm and tv receivers. Not only have valuable auxiliary testing facilities been incorporated, such as a noise locator circuit and a calibrated wattmeter, but careful attention has been given to the basic requirements of good audio quality and high sensitivity. Features, applications, and specifications are given below

FEATURES AND APPLICATIONS

1. Two input channels: high-gain RF and low-gain audio. RF channel gain more than adequate for tracing up to receiver input.

2. Both visual and aural signal monitors (eye tube and speaker). Visual monitor permits easier estimation of signal strength and gain-per-stage.

3. Shielded RF crystal demodulator and direct probes provided. Individual panel receptacles provided for easy change-over from RF to audio tracing or visa versa.

4. Valuable noise locator circuit ferrets out noisy controls, resistors, capacitors, coils, transformers, cold solder joints, etc.

5. Calibrated wattmeter affords rapid preliminary check of power consumption in equipment under test. Detects B+ short, intermittent filament circuit, defective filter or bypass capacitors, etc. Fuse for safety.

6. May be connected as substitute speaker, amplifier, or output transformer.

7. Output for VTVM or oscilloscope.

8. Transformer operated for isolation and safety.

SPECIFICATIONS

<u>Tube & Diode Complement:</u> 1- 12AX7 dual triode as voltage amplifiers, 1- 6AQ5 as beam power amplifier, 1-1629 electron-ray indicator, 1- 6X4 as full-wave rectifier, 1- 1N48 germanium diode as wattmeter rectifier.

<u>Power Requirements</u>: 105-125 volts ac, 50/60 cycles.

<u>Size:</u> 8" high, 10" wide, 4 3/4" deep.

<u>Shipping Weight:</u> 11 pounds

CIRCUIT DESCRIPTION

The Model 147A Signal Tracer is basically a transformer-operated three-stage, high gain audio amplifier. A 1629 eye tube is connected to the grid of the third stage to provide visual monitoring of the signal level while a speaker is coupled to the output for aural monitoring. The first stage is intended primarily to preamplify the audio stripped from the a-m broadcast or test oscillator signal by the RF crystal demodulator probe. The last two stages form a low-gain audio amplifier provided with a separate input and a direct audio probe. In this way, normal audio circuit exploration can be carried on with the possibility of amplitude or rectification distortion minimized and the lowest possible hum and noise level. As the gain control is in the grid circuit of the second stage, it is effective when either channel is used. Additional test facilities provided are a built-in calibrated wattmeter, a noise locator circuit, and substitute test speaker, amplifier, and output transformer.

One triode section of the 12AX7 tube (V1A) is the preamplifier or first stage; the other triode section of the 12AX7 tube (V1B) is the second amplifier and is coupled conventionally to the 6AQ5 beam power output tube V2, which is the third amplifier. A 1N48 germanium diode provides the retification required for the wattmeter circuit. The primary of the output transformer connected to the last stage is tapped so that substitution may be made for the output transformer in either a single-ended or push-pull amplifier.

A panel switch (INPUT SELECTOR S1) in the grid circuit of the V1B tube section permits this grid to be connected in the following ways: a) to the plate of the V1A triode preamplifier for RF signal tracing: b) to the AUDIO panel connector via blocking capacitor C2 for low-gain audio signal tracing; c) same as (b) but approximately 130 VDC placed on AUDIO panel connector for application to suspected components in NOISE testing.

Another panel switch, OUTPUT SELECTOR S2, connects the eye tube for either tracing or wattmeter use (via section S2A) and for tracing or the various substitution tests (via section S2B). Section S2B also switches AC supply power on and off. As the power must be off when the instrument is used as a substitution output transformer, AC OFF and TEST OUT. XFMR are the same position of the switch. At the TRACE and TEST AMP-TEST SPKR. positions, the power is on as is obviously required for the TRACE and TEST AMPLIFIER functions (although not for the TEST SPKR. function).

The transformer-operated, full wave rectifier power supply utilizes a quadruple electrolytic filter capacitor to provide maximum filtering for hum-free operation. The hum level is further reduced by a hum-balancing control. As a result

In the case of a transformer-operated receiver as an example, the wattmeter indications would be interpreted as follows. A preliminary wattmeter check showing normal power consumption would indicate that at least the power transformer is o.k. and if there is power supply trouble at all, it may be found to lie in a weak rectifier, weak filter capacitor, or at some point further on. If, however, the power drain is abnormally high, the next step would be to remove the rectifier tube and observe whether or not the power drain falls to approximately normal. If it does, then a defective filter or bypass capacitor is indicated, or possibly a short filter choke or bleeder, or a gassy rectifier. (To check a filter capacitor which is suspected, just disconnect one end from the circuit and observe whether or not the power consumption drops noticeably. If it does, replace the filter capacitor.) If abnormally high power consumption is not reduced by removing the rectifier, then a short in the power transformer is indicated.

To establish the cause of low power consumption, short the B plus circuit to ground momentarily at the filter capacitor output and note the power consumption while doing so. Abnormally high power consumption would be normal under this circumstance and low consumption would point to a weak or gassy rectifier or possibly a defect in the power transformer.

WATTMETER MAINTENANCE NOTE: Failure of line voltage to appear at the WATTMETER LOAD receptacle (with OUTPUT SELECTOR set at WATTMETER) indicates that in all probability the wattmeter circuit fuse (5A), located on the underside of the chassis, has blown due to an overload.

NOISE LOCATOR

The noise locator circuit is used to locate noisy and intermittent components. A filtered dc voltage taken from the power supply is applied via the audio probe to the suspected component and the effect amplified so that it is heard through the speaker and observed on the eye. The ground clip of the audio probe, of course provides the necessary ground return circuit. The applied voltage at no load is about 130 vdc (±20%), but there is no danger of damaging receiver components since the short circuit current is about 1 ma. Some care should be taken in handling the probe although the shock that can result from careless handling is relatively harmless.

Noise locator tests are made only when the receiver under test is completely disconnected from the a-c line. The instrument is set up for noise testing by setting the INPUT SELECTOR at NOISE, the GAIN control at near maximum clockwise rotation, and the OUTPUT SELECTOR at TRACE. The following is a typical example of noise location procedure, taking the plate circuit of the IF stage as an example: Connect the audio probe ground clip to the B plus supply point and apply the audio probe to the plate of the IF tube. If a sharp clean click is heard at the instant of contact, with no frying, crackling, or buzzing sound afterwards as the probe is held at the test point, it indicates that there are no noisy or intermittent components in the path from the plate of the IF tube to the B plus point to which the ground clip is connected. If frying, crackling, or buzzing is heard, then there is a noisy or intermittent component in the path. In the latter case, the obvious procedure is to move the test probe down toward the B plus point, checking at each junction between two components in the path. In all likelihood, the noise indication will disappear at some point along the path. When this occurs, return the test probe to the last point at which the noise indication appeared, and check the component between this point and the point at which the noise indication disappeared for a possible defect.

The noise locator test will show up noisy and intermittent resistors, volume and tone controls, capacitors, and cold solder joints. The part under test should be jiggled or prodded in order to determine whether or not an intermittent or noisy condition exists.

PANEL CONNECTIONS

For the utmost flexibility and convenience, seven pin jacks are provided on the panel for connection of the instrument as a substitute amplifier, substitute speaker, substitute output transformer, and for connection of the signal tracer output to a vtvm or 'scope. Specific instructions follow for setting up and connecting to the instrument for each function.

<u>SUBSTITUTE SPEAKER:</u> With the OUTPUT SELECTOR set at TEST SPKR-TEST AMPL, the voice coil terminals of the internal speaker are available at the TEST SPKR and GND pin jacks.

<u>SUBSTITUTE AMPLIFIER:</u> With the OUTPUT SELECTOR set at TEST SPKR-TEST AMPL, connections to the output transformer secondary of the tracer amplifier are available at the TEST AMPL and GND pin jacks.

<u>SUBSTITUTE OUTPUT TRANSFORMER (PLUS SPEAKER):</u> With the OUTPUT SELECTOR set at AC OFF-TEST OUT. XFMR, connect the plate lead of single-ended power amplifiers to either P pin jack and the B+ lead to the B+ pin jack. For push-pull amplifiers, connect one power amplifier plate lead to one P pin jack and the other plate lead to the other P pin jack; connect the B+ lead to the B+ pin jack. The OUTPUT SELECTOR should be turned to AC OFF-TEST OUT.XFMR before connections to the output transformer pin jacks are made (there is a dangerously high B+ voltage on the B+ pin jack when the instrument is on). The OUTPUT SELECTOR should not be moved from the OFF position during the test or before unmaking the pin jack connections at the conclusion of the test.

this method should eventually gain the preference of the operator for rapid service work. For an actual numerical check of gain-per-stage, a 'scope or vtvm should be connected to the panel terminals provided. The GAIN control can be used to establish any desired reference level. The signal tracer will provide more than enough gain to permit easily observable differences in readings or deflections.

Let us take the case of the weak receiver as a typical servicing problem, and outline the signal tracing method of locating the cause of the trouble. It is assumed that routine checks of tubes, of voltages on tube elements, of line voltage, and of adequacy of antenna for receiver and location, as well as a wattmeter test, have not revealed the reason for weak signals, and that therefore signal tracing is indicated. As the receiver is operative, either tune the receiver to a local station, preferably around 600 kc, or connect a signal generator between the antenna and ground terminals and feed a 600 kc audio-modulated signal to the operating receiver. Turn down the volume control of the receiver as it is the sound emanating from the signal tracer speaker which is of interest during the tests, not the sound from the receiver speaker. Connect the ground lead of the RF probe to B minus or ground of the receiver under test and apply the test probe directly to the antenna terminal or to the antenna loop. Turn up the signal tracer gain control until sufficient indication of the signal level is obtained. The test probe can then be moved along the normal signal path point-by-point; to the grid and then the plate of the RF stage, if one is present; to the grid and then the plate of the mixer or converter tube; to the grid and then the plate of the first IF tube; and then to the grid and plate of any other IF tubes, in order, and on into the detector stage. As was discussed previously, the operator will with experience come to know whether or not normal stage gain is being obtained in each particular stage.

It should be noted that the input capacity of the RF probe may in some cases be sufficiently large to cause a slight detuning effect when touched to tuned circuits and may induce oscillation. If this should occur, it would generally be wiser to pass on to the next test point rather than to conclude that the receiver is defective in this respect. If the receiver gives good signal indication at the next test point, in all likelihood the effect just described is responsible and the receiver is operating properly.

AUDIO SIGNAL TRACING

To trace the signal through the audio stages following the detector in the receiver circuit, neither the RF probe nor high gain is required. To provide the best fidelity of reproduction and the lowest possible hum and noise level, a shielded direct probe and the low gain audio channel are used. The audio probe is plugged into the AUDIO INPUT pin jacks, and the INPUT SELECTOR set at AUDIO to connect to the low gain amplifier. Here again, the OUTPUT SELECTOR is set according to the desired use of the eye tube and the speaker. Note that all output transformers in receivers are of the step-down type to match the relatively high impedance of the output tube plate circuit to the low impedance of the speaker. Naturally, therefore, a sharp drop in signal voltage will be observed when the probe is moved from the primary winding of the output transformer to the secondary winding. Elsewhere in the a-f section, of course, the gain increases as the probe is moved from the detector toward the speaker.

It is important to realize that the presence of signal at a particular point may indicate improper operation just as much as the absence of signal at some other point. For example, it is common practice to employ a large capacitor to bypass the bias resistor in the cathode circuit of the output stage. If signal voltage is picked up at the cathode, obviously the bypass capacitor is not performing its function and is probably open.

WATTMETER

The wattmeter circuit is extremely valuable for servicing tv, a-m & f-m radio, P.A. equipment, or any electronic devices operating from the a-c line and not drawing more than 500 watts normally.

To use the instrument as a wattmeter, set the OUTPUT SELECTOR at WATTMETER. The INPUT SELECTOR may be set at any position, and the GAIN control should be turned maximum-counter-clockwise as the amplifiers are not employed in this function. After preliminary resistance checks of the equipment have been made to ensure that it is safe to apply power to the receiver and that a short does not exist which would cause so much current to be drawn through the wattmeter as to cause the fuse to blow, plug the line cord of the equipment under test into the WATTMETER LOAD receptacle on the panel. Then turn on the receiver and allow a short warm-up period for the receiver to reach normal operating conditions. Adjust the WATTMETER control until the shadow angle on the eye tube just closes with no overlapping of the edges of the bright sector and read the power consumption in watts directly from the calibrated dial. The eye will close even at zero on the dial, unless the drain is at least 35 watts. This is not a disadvantage in checking the great many receivers drawing 30 watts or so normally, since a short will bring the power consumption to well over 35 watts and therefore unquestionably show up in this test. Also, at zero on the dial a 30 watt receiver will produce a considerably narrowed shadow angle from the maximum which is sufficient indication of normal loading.

The wattmeter reading can then be compared with the normal power consumption of the receiver which is usually given on the chassis label. As the wattmeter circuit is responsive only to the current drawn and the dial calibrations are drawn on the basis of the average U. S. line voltage of 117 vac, obviously the accuracy of the reading will depend on the actual line voltage as well as the actual power factor of the equipment under test. In general, therefore, it would not be reasonable to expect accuracy greater than 10%.

PARTS LIST

Stock#	Sym.	Description	Am't.
22513	C1	cap., disc., .005 mfd (5K or 5000 mmf) ±10%	1
22517	C2,3,4	cap., disc., .025 mfd (25K or 2500 mmf) ±10%	3
24003	C5	cap., elec., 2x20/450V - 2x10/350V	1
20044	C6	cap., molded, .25 mfd - 400V	1
95000	CR1,2	rectifier, 1N48	2
91003	F1	fuse, 5A, slo-blo	1
50001	J2,7,8,9,10	jack, pin, black	5
50000	J1,4,5,6	jack, pin, red	4
50002	J3	mic. connector male	1
50009	J11	receptacle, AC	1
10402	R1	res., 10MΩ (brown, black, blue, silver) 1/2W, ±10%	1
10431	R2,8,20	res., 470KΩ (yellow,violet,yellow,silver) 1/2W, ±10%	3
10410	R3	res., 100KΩ (brown, black, yellow, silver) 1/2W, ±10%	1
10417	R4,7	res., 220KΩ (red,red,yellow,silver) 1/2W, ±10%	2
18043	R5	pot., 500KΩ audio taper	1
10423	R6	res., 2.2KΩ (red,red,red,silver) 1/2W, ±10%	1
10862	R9	res., 330Ω (orange,orange,brown,silver) 1W, ±10%	1
10407	R10,16, 17,19	res., 1MΩ (brown, black, green, silver) 1/2W, ±10%	4
10436	R11	res., 47Ω (yellow,violet,black,silver) 1/2W, ±10%	1
10409	R12	res., 560KΩ (green,blue,yellow,silver) 1/2W, ±10%	1
14501	R13	res., 1KΩ, 5W, ±10%	1
10428	R14	res., 47KΩ (yellow,violet,orange,silver) 1/2W, ±10%	1
10422	R15	res., 68KΩ (blue,grey,orange,silver) 1/2W, ±10%	1
16004	R18	pot., 50KΩ, linear	1
60053	S1	switch, input selector	1
60054	S2	switch, output selector	1
55000	SP1	speaker	1
32009	T1	transformer, output	1
30023	T2	transformer, power	1
32003	T3	transformer, current	1
54004	TB1,2	terminal strip, 2 post with ground	2
54013	TB3,4,5	terminal strip, 1 post left with ground	3
90034	V1	tube, 12AX7	1
90047	V2	tube, 6AQ5	1
90036	V3	tube, 6X4	1
90015	V4	tube, 1629	1
97025	XV1	socket, 9 pin min. bottom mount	1
97024	XV2,3	socket, 7 pin min. bottom mount	2
97013	XV4	socket, octal, molded	1
40000		nut,hex #6-32	14
40001		nut,hex 3/8-32	4

Stock#	Description	Am't.
40007	nut, hex, #4-40	6
41000	screw, #6-32 x 1/4	12
41001	screw, #10-24 x 3/8	2
41014	screw, #6-32 x 3/8	2
41016	screw, #4-40 x 1/4	6
41035	screw, #6 P.K.	9
42000	washer, 3/8 lock	6
42001	washer, 3/8 flat	4
42002	washer, #6 lock	14
42007	washer, #4 lock	6
42012	washer, star (for pin jacks)	9
42019	washer, rubber	1
43000	lug, #6 ground	1
43001	lug, 3/8 pot ground	1
46000	grommet, 3/8 rubber	1
46005	feet, rubber	4
47001	spring	1
51000	connector, female	1
51004	tip, pin	2
51502	clip, crododile	2
53006	knob, round bar	4
54507	board, probe	1
55301	grill, speaker	1
55500	probe, red	1
57000	line cord	1
58004	wire, hook-up	length
58300	spaghetti	length
58401	cable, mic.	length
58403	cable, grey	length
58501	wire, bare, #22	length
58502	braid, flat	length
80056	panel	1
81055	eye bracket	1
81122	chassis	1
87000	handle	1
88021	cabinet	1
89511	probe, nosepiece	1
89512	probe, tip	1
89524	probe, shell	1
66062	instruction manual (wired)	1
66311	instruction manual (kit)	1

NOTE: When ordering replacement parts, please include all of the following information: 1) stock number and description given in parts list; 2) quantity; 3) model number of instrument; 4) serial number of instrument (on panel). This information will expedite the processing of your order and insure your receiving the correct replacement parts.

SERVICE

If trouble developes in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. If desired you may return the instrument to our factory where it will be placed in operating condition for $5.00 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, New York. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.

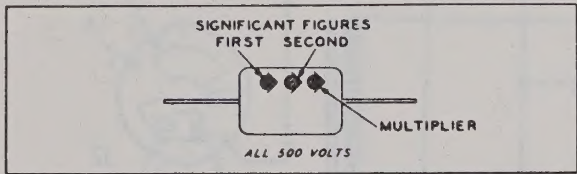
VOLTAGE AND RESISTANCE CHART

TUBE	PIN#	VOLTS	OHMS (UNIT OFF)
ECC83/12AX7	1	75VDC	270KΩ
	2	0	0
V1	3	0.9VDC	2.2KΩ
	4&5	6.3VAC	0
	6	100VDC	330KΩ
	7	-1 VDC (approx.)	10 Meg Ω
	8	0	0
	9	0	0
6AQ5	1	0	470KΩ
	2	13VDC	330Ω
V2	3	0	0
	4	6.3VAC	0
	5	260VDC	1.15KΩ
	6	265VDC	1KΩ
	7	0	470KΩ
6X4	1	270VAC	250Ω
	2	-	-
V3	3	0	0
	4	6.3VAC	0
	5	-	-
	6	270VAC	250Ω
	7	310VDC	100KΩ or greater
1629	1	-	-
	2	6.3VAC	0
V4	3	18VDC	1 Meg Ω
	4	260VDC	1KΩ
	5	-0.8VDC	500KΩ
	6	-	-
	7	6.3VAC	0
	8	0	0

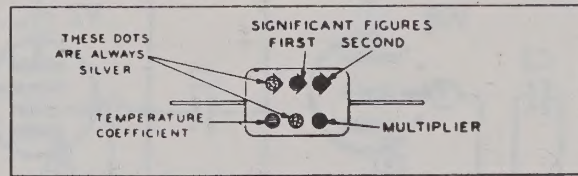
Voltages given are operating voltages measured with no signal. Resistances are measured to ground with unit off. Cathode of rectifier (pin 7 of V3) shorted to ground during all resistance measurements except when measuring resistance from pin 7 of V3 to ground. CONTROL SETTINGS: GAIN at minimum, INPUT SEL. to RF, OUTPUT SEL. to TEST SPKR., WATTS to 0. Voltage measurements are made with a VTVM or 20,000Ω/V VOM. Operating line voltage at which voltage measurements are made is 117VAC, 60cps. NOTE: ALL VOLTAGE & RESISTANCE VALUES MAY VARY NORMALLY BY ±15%.

CAPACITOR COLOR CODES

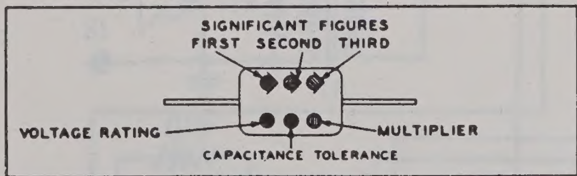
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



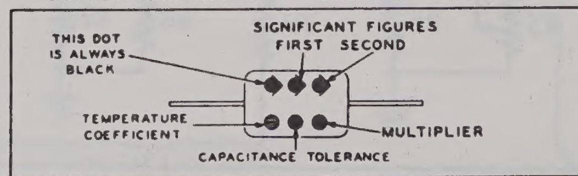
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



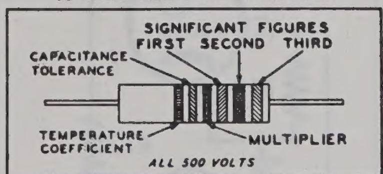
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

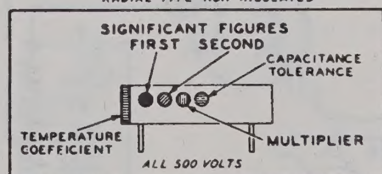


RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

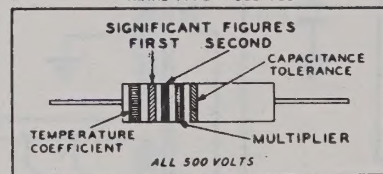


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

RADIAL TYPE NON-INSULATED



AXIAL TYPE INSULATED



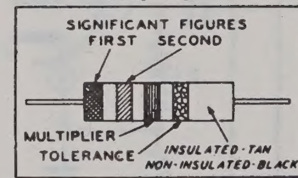
RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

RESISTORS				CAPACITORS				
				MULTIPLIER				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1		A
	10	1	BROWN	10	10	10	100	B
	100	2	RED	100	100	100	200	C
	1,000	3	ORANGE	1,000	1000	1000	300	D
	10,000	4	YELLOW	10,000			400	E
	100,000	5	GREEN	100,000			500	F
	1,000,000	6	BLUE	1,000,000			600	G
	10,000,000	7	VIOLET	10,000,000			700	
	100,000,000	8	GRAY	100,000,000		0.01	800	
	1,000,000,000	9	WHITE	1,000,000,000		0.1	900	
5	0.1		GOLD	0.1	0.1		1000	
10	0.01		SILVER	0.01	0.01		2000	
20			NO COLOR				500	

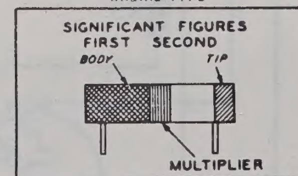
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE

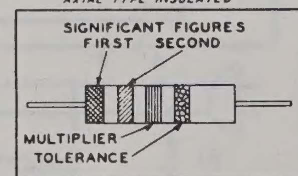


RADIAL TYPE

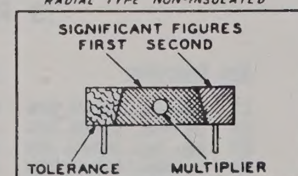


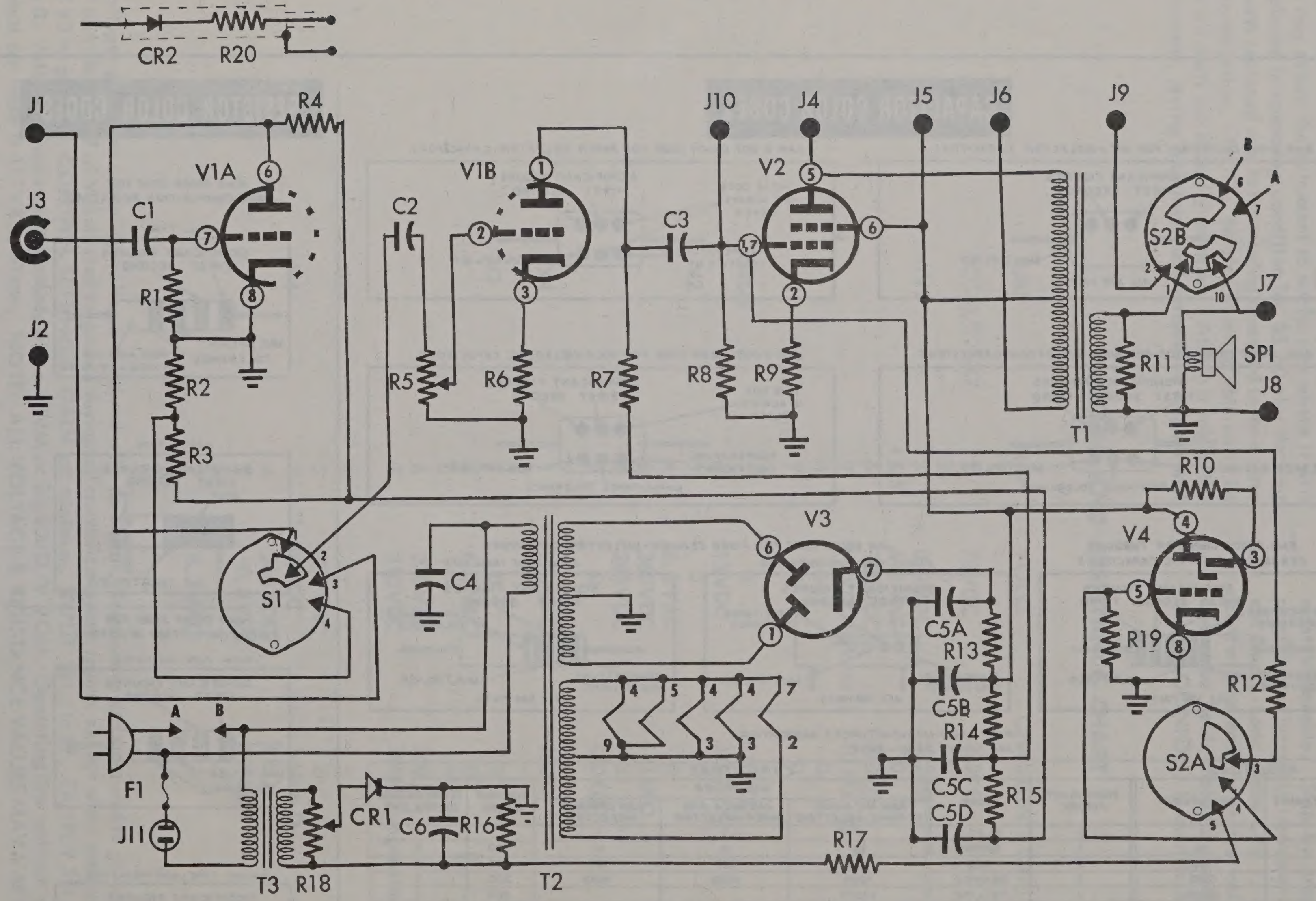
JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED





Sym.	Description
C1	cap., disc., .005 mfd, 10%
C2	cap., disc., .025 mfd, 10%
C3	cap., disc., .025 mfd, 10%
C4	cap., disc., .025 mfd, 10%
C5	cap., elec., 2x20/400V 2x10/350V
C6	cap., molded, .25 mfd-400V
CR1	rectifier, 1N48
CR2	rectifier, 1N48
F1	fuse, 5A, slo-blo
J1	AF Input
J2	Ground
J3	RF Input
J4	Plate (output transformer)
J5	B+ (output transformer)
J6	Plate (output transformer)
J7	Test Speaker
J8	Ground
J9	Test Ampl.
J10	VTVM Scope
J11	Wattmeter
R1	res., 10MΩ, 1/2W, ±10%
R2	res., 470KΩ, 1/2W, ±10%
R3	res., 100KΩ, 1/2W, ±10%
R4	res., 220KΩ, 1/2W, ±10%
R5	pot., 500KΩ audio taper
R6	res., 2.2KΩ, 1/2W, ±10%
R7	res., 220KΩ, 1/2W, ±10%
R8	res., 470KΩ, 1/2W, ±10%
R9	res., 330Ω, 1W, ±10%
R10	res., 1MΩ, 1/2W, ±10%
R11	res., 47Ω, 1/2W, ±10%
R12	res., 560KΩ, 1/2W, ±10%
R13	res., 1KΩ, 5W, ±10%
R14	res., 47KΩ, 1/2W, ±10%
R15	res., 68KΩ, 1/2W, ±10%
R16	res., 1MΩ, 1/2W, ±10%
R17	res., 1MΩ, 1/2W, ±10%
R18	pot., 50KΩ, linear
R19	res., 1MΩ, 1/2W, ±10%
R20	res., 470KΩ, 1/2W, ±10%
S1	Input Selector
S2	Output Selector
SP1	speaker
T1	output transformer
T2	power transformer
T3	current transformer
V1	tube, 12AX7
V2	tube, 6AQ5
V3	tube, 6X4
V4	tube, 1629

MODEL 147 A SIGNAL TRACER